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"OJCS Computer Expansion"

COMPUTER SYSTEMS PLANNING REPORT

JUNE 1974

OFFICE OF JOINT COMPUTER SUPPORT

DIRECTORATE OF MANAGEMENT AND SERVICES

CENTRAL INTELLIGENCE AGENCY

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FOREWORD

This is a plan for the computer systems in the Office of Joint Computer Support (OJCS) during the period FY-75 through FY-78.

The first step in the development of this plan was on 31 July 1973 when the Director, OJCS appointed an Ad Hoc Planning Group to develop a plan for FY-74 - FY-76.

The Planning Group submitted its plan to the OJCS Management Committee on 29 November 1973. For batch service the plan would have replaced the IBM 360/195 and IBM 360/65-1 with two IBM 370/168 computers. Both IBM 360/67's would have been used for CP/CMS. Two more 370/168's were proposed later for on-line workloads being handled by two IBM 360/67's and an IBM 360/65 in OJCS and two IBM 370/158's in the DDO/[redacted] computer organization. (It should be noted that plans for a merger of OJCS and ISG computer facilities were in discussion at this time.) The OJCS Management Committee had major concerns with the plan: the propriety of planning changes to the ISG systems before we had more experience with the operation of these systems, the productivity of 370/168's compared with the 360/195, CRS' Support for the Analysts' Environment (SAFE) requirements, the pace of proposed changes, and other technical details.

25X1

On 15 January 1974 the Director, OJCS asked the Systems Engineering Division to take the plan and, with additional guidance provided by the OJCS Management Committee, develop a more detailed plan by 1 March 1974.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

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There followed frequent briefings of the OJCS Management Committee by SED as they developed what might be called the second draft of the hardware plan. This plan was presented to the Management Committee on 26 March 1974. A number of recommendations concerned with near-term changes in disk storage capacity were approved. Other issues were discussed: earlier implementation of VM 370, elimination of the proposed increase in 360/195 core storage, and altered schedules for major system installations. The Director OJCS requested SED to provide some alternatives in the plan for early improvement in the service to CP/CMS users.

Such alternatives were prepared and discussed in the OJCS Management Committee on 17 April 1974. It was decided to provide a new express batch service for compilations to relieve some of the workload on the CP/CMS system. Later (3 May 1973) the Director, OJCS met with SED representatives and there evolved the broad concept of the plan which is presented here--in effect, the third system plan.

Major developments in OJCS computer activities have occurred since work began on this plan:

- General period of reorganization in the Agency and OJCS.
- Merger of CRS computer operations with OJCS.
- Reorganization of the MAP effort to speed up implementation of priority applications and DAC operations.
- Expedited installation of an IBM 370/158 to replace IBM 370/67-2.
- A heavy workload in development of new applications and changes to on-going systems.
- Planning for the consolidation of DDP/[redacted] computer activities with OJCS. 25X1
- Development work on the ORACLE mass storage system.

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Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

- More stringent procurement procedures for ADP equipment.
- Introduction of an ADP Resource Allocation System to improve the management of ADP resources.

A lesson learned in the development of this plan is that the business of planning for computer resources has become much more complex with the new computer technology and the new types of computer applications being developed by OJCS and its users. Statistical data and measurement factors used for requirements projections have been hotly contested by computer experts with differing views. Without definitive guidance from OJCS' customers it is impossible to accurately predict their requirements and attendant impact on the Agency's computer system. The time required to introduce new operating systems, install computer equipment, and produce stable systems cannot be accurately predicted. The impact on the computer systems, from new applications or alterations in the computer configurations, is difficult to gauge. Planning for new systems is limited by physical space in which to locate new computer systems without major disruptive impact on the customers. It is clear that we will have to be prepared to make changes in this long-range plan as we implement it, gain more experience and knowledge, and the customers' future requirements are better defined through the ADP Resource Allocation System.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

CONTENTS

		Page
I.	Introduction	1
II.	Objectives of Plan	3
III.	Current Operations	6
IV.	Workload Projections	10
V.	Major Milestones in Plan	13
VI.	Costs for Plan	17
VII.	Alternatives	27
VIII.	Major Issues and Uncertainties	31

SECRET

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

I. Introduction

The computer systems included within the scope of this plan comprise the equipment and operating system software installed in the OJCS Computer Center, room GC-03, Headquarters building, and other remotely located equipment that is normally associated with these systems and funded by OJCS. The DDO [redacted] computer facilities are not included in this plan. 25X1

The activities concerned with the development of computer applications for users of the OJCS Computer Center--problem analysis, system design, programming--are also beyond the scope of this report.

The reader is assumed to have some familiarity with the general characteristics of the computers, system software, and major user applications referenced in this report. Whenever central processor unit (CPU) time is used in the report, it is expressed in terms of equivalent IBM 360/65 time in order to provide a standard unit of measure.

It will be noted that complete details for implementation of the plan are not included. Plans for training, site preparation, installation of equipment, preparation of system software, testing, and conversion of application programs will be developed separately in accordance with the schedule for changes in the computer systems. The schedules in this report can be affected by procurement processes, changes in user requirements, or experience gained during the implementation phases. Thus it is anticipated that the plan will be revised annually.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

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Section II of this report describes the computer system performance objectives for the plan. Section III describes the current computer configuration and the kinds of service provided. Section IV shows the workload projections. Section V lists the major milestones. Section VI shows the costs for components of the system by fiscal year and milestone. Section VII describes alternatives which have been considered and Section VIII deals with the major issues and uncertainties in the report.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

II. Performance Objectives

It is quite easy to express in general terms the performance objectives for the computer systems which comprise the OJCS Computer Center:

> To provide greater capability, capacity, reliability, and availability from the computer systems which provide batch and on-line services.

It is more difficult to express performance objectives in quantitative terms that are simply defined, readily measured, and universally accepted as valid indicators. For example, response time for various users of the CP/CMS system may be defined differently depending on the function being performed by a particular user and his judgment of what constitutes satisfactory response time. In general, the user expects the system to respond as fast as he is able to enter data and work with the results. When the user finds that he is able to work with the data faster than the computer can support him, the service is often judged unsatisfactory. This state can be reached in three ways: putting more terminals in use than the system can logically support; using the system for functions that make heavy drains on the resources of the system; providing a system that is unstable. Apart from response time, there are the questions of stability and availability. Hardware, software or other problems can cause the system to go down, thus causing considerable inconvenience to the user because of the period that the system is out of service and the lost work or restart operations which are necessary when the system is brought back in service.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

The quality of batch service performance is generally measured in terms of turnaround time--the time between submission of the job to the computer center and completion of the job. Jobs with categories A, B, D, and E have special factors which establish the turnaround objective. For example: A - highest priority, complete by a specified time and date using prime time; B - programmer must be present for run; D - by 0800 the next day; E - on "time-available" basis but no later than a specified date and time. Category C jobs (approximately 66% of the total jobs) are to be processed during prime time as soon as the normal batch queue will permit. The Category C jobs, therefore, are those that most need a turnaround objective. For the average Category C job, one which takes only a few minutes of CPU time to process and produce output, the turnaround time can include processing time. For larger jobs, where the processing time can run to several hours, the measurement of turnaround time must exclude actual processing time in order to provide a meaningful measure. Very few Category C jobs are large jobs. System stability and system availability, of course, provide additional measures of the quality of batch service.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

A reasonable set of performance objectives for the computer center is:

		Batch	On-Line
Stability:	Mean time between failures of the system.	24 hours	48 hours
Availability:	Percent of scheduled use time that the system is available for production.	95%	95%
Turnaround:	Less than 14 minutes of IBM 360/65 CPU time.	1 hour	N/A
	More than 14 minutes of IBM 360/65 CPU time.	1 hour plus processing time	N/A
Response time:	Responsiveness of CMS or other on-line systems to user needs.	N/A	*

*Varies with each on-line system and function performed.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

III. Current Computer Operations

The current computer systems include:

1	IBM 360/195 (2 million bytes of memory)
2	IBM 360/65 (1.5 and 2.5 million bytes of memory)
1	IBM 360/67 (1 million bytes of memory)
1	IBM 370/158 (2 million bytes of memory)
2	IBM 360/20
2	PDP 11
2	Plotters
1	Page Reader

Peripherals include:

176	Disk Drives
40	Tape Drives
8	Printers
5	Card reader/punches
5	Line printers/card readers (Remote)
7	Drums

Computer terminals include:

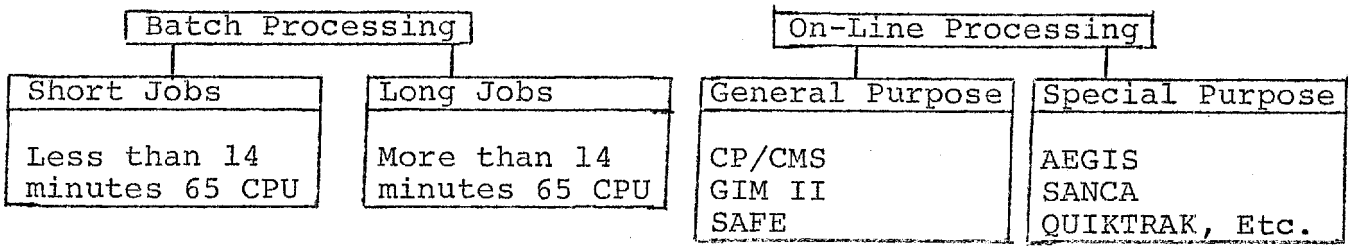
196	CRT terminals
85	Hard copy terminals

Switches and channel-to-channel adpaters are used to provide flexibility in the operation of the large computers for backup, sharing of disks, and different use of computers during prime shift and other shifts. During the prime shift, the normal configuration provides the IBM 360/65-1 as the ASP support processor and the IBM/195 as the ASP main. The IBM 360/65-2 is used for a general purpose on-line system, GIM II, which supports terminal applications such as MAP, CIRIS, CONIF. The IBM 360/65-2 also supports special purpose on-line applications such as QUIKTRAK, CRS-OLDE and SANCA. The IBM 370/158 is used for special purpose on-line terminal applications such as AEGIS, OLTA, COLTS, etc. The IBM 360/67-1 is used for CP/CMS time

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

shared interactive service. A link exists between the CP/CMS service and ASP service such that jobs can be transferred from the CP/CMS system to the ASP system for batch processing. After prime shift operations, four of the five major computers can be connected in an ASP network.

In general OJCS computer service may be classified as follows:



The batch processing job mix may be described in general terms as follows:

- Batch processing handles about 1100 jobs a day
- The source of these is: 60% CP/CMS, 30% local card readers, 10% remote card readers
- 40% of the jobs require mounting of tapes and disks (1000 tapes and 200 disk packs a day)
- 95% of the jobs use 25% of the total CPU time used
- 5% of the jobs use 75% of the total CPU time used

The CP/CMS time sharing system (IBM 360/67-1) is used by over 400 people a month, with 200 people using it on any given day and more than 70 terminals active during peak periods. The CP/CMS services most frequently used are:

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- File editing and batching to ASP System
- Program Compilation and check out
- Execution of interactive programs
- Information retrieval
- APL
- Editing and printing SCRIPT files

The two computers dedicated to on-line applications (360/65-2) and (370/158-1) support over thirteen independent systems, each of which employs one or more terminals during prime shift. One of these systems, GIM II, is a generalized system that is used for a number of different applications. The remaining systems are tailored to a specific user such as SANCA, QUIKTRAK, etc.

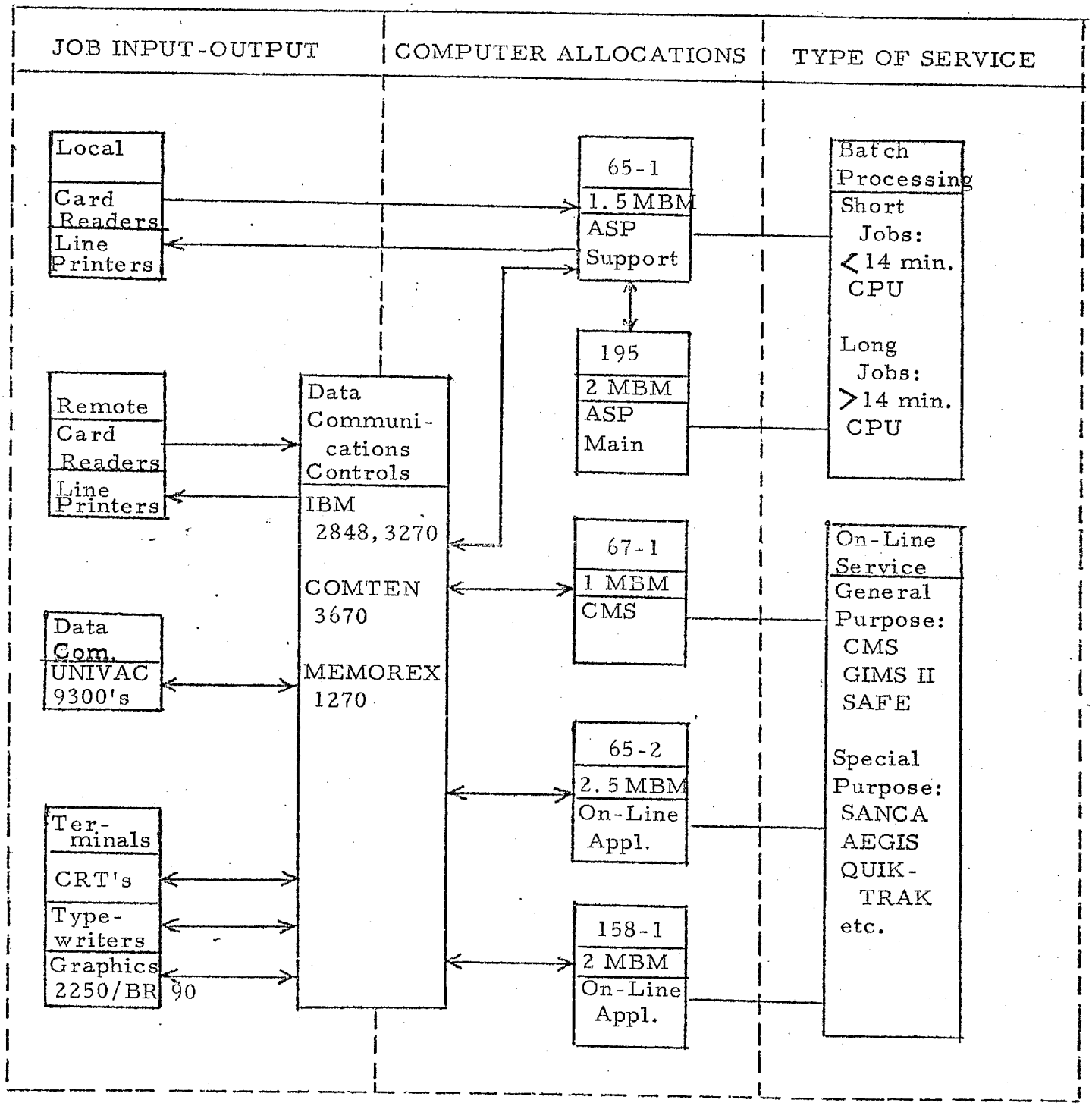
The Computer Center is in operation 24 hours a day, 7 days a week. It occupies 13,000 square feet of space. Equipment is supplied by 20 manufacturers, the largest being IBM; but significant quantities of equipment are also furnished by CDC, Memorex, COMTEN, CalComp and Delta Data. The physical inventory of computer equipment comprises over 850 units. The FY-74 rental was [redacted] equipment purchases were $1,000,000, 25X1 equipment maintenance was $225,000, and costs toward the development of the ORACLE mass storage system were $800,000.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

OJCS COMPUTER CENTER

CURRENT SYSTEMS



NOTES: MBM = Million Bytes of Memory
UNIVAC 9300's are Office of Communications equipment.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

IV. Workload Projections

Historical data and projection data for workloads is greatly affected by many events occurring during the period. These, in effect, change the OJCS computer systems and the mix of work being processed such that a constant model or base for workload projections is difficult if not impossible, to maintain.

For example, the installation of the 360/195 in May 1972 provided a great increase in computer power which permitted jobs to be turned around more quickly. This, in turn, created a situation in which more jobs were submitted. The result was a buildup in the number of jobs which may have been more a function of available capacity than true workload.

Also, during FY-74 CRS computer processing was consolidated with OJCS. The release of the CRS 370/155 computer (November 1973), and the replacement of the OJCS 360/67-2 with an IBM 370/158 (March 1974) took place during a period in which there was an apparent buildup in CRS workloads.

Add to these events the beginning of the buildup in MAP production, the merger of DDO/ computer activities, the uncertainties in the pace of SAFE development, and other unknowns, and it will become apparent that any projection of computer workload can be contested. The projections are the best that could be made at this time, and they provide the basis for the planned computer systems.

25X1

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

OJCS will begin to manage the DDO [redacted] computer facilities in FY-75. 25X1
These facilities will be handled as a separate entity at least through
FY-75. Because of the timing of the [redacted] merger with OJCS and the lack of 25X1
substantial working experience with [redacted] computer applications and workloads, 25X1
no changes in [redacted] equipment have been included in this plan. The [redacted] system 25X1
plan for FY-75 will be the governing plan; such modifications as may be
mutually agreed upon will be implemented.

Projections for On-line Applications:

Number of Installed Terminals as of 30 June							
	1972	1973	1974	1975	1976	1977	1978
SAFE Only	-	-	6	20	50	150	300
Other	119	180	275	350	450	550	650
TOTAL OJCS	119	180	281	370	500	700	950

Number of Active Terminals During Peak Periods as of 30 June							
Generalized Systems	1972	1973	1974	1975	1976	1977	1978
CP/CMS	28	48	70	100	200	260	300
GIM II	5	12	16	32	45	55	65
SAFE	---	---	3	9	25	50	100
TOTAL	33	60	89	141	270	355	465
Specialized Systems							
SANCA, AEGIS, SHOE-BOX, Etc.	12	12	12	12	12	12	12

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

SECRET

Average Daily Batch Workload Measured IBM 360/65 Hours
as of 30 June

	1972		1973		1974		1975		1976		1977		1978	
	Jobs	CPU	Jobs	CPU	Jobs	CPU	Jobs	CPU	Jobs	CPU	Jobs	CPU	Jobs	CPU
Small Jobs	750	16	900	18	1100	21	1300	25	1500	29	1700	33	1900	37
Long Jobs	30	20	50	45	60	66	70	79	80	92	90	105	100	118
TCTAL	780	36	950	63	1160	87	1370	104	1580	121	1790	138	2000	155

Notes: 1 - 370/195 CPU Hour = 7 - 360/65 CPU Hours

1 - 370/168 CPU Hour = 4 - 360/65 CPU Hours

A 360/195 was installed during the last quarter of FY-72.

CRS consolidation impact began in July 1973.

Short jobs are normally run during prime time and require quick turnaround.

Long jobs are normally run overnight and on weekends.

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Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

V. OJCS COMPUTER SYSTEM PLAN - FY-75 - FY-78

MAJOR MILESTONES

1. October 1974

Install IBM 370/158-2 computer and VM 370 software as an expanded capacity replacement for the IBM 360/67-1 computer and CP/CMS software. Begin to transfer the CP/CMS workload to the new IBM 370/158 system.

2. December 1974

Complete the transfer of the CP/CMS workload to IBM 370/158-2. Begin to use IBM 360/67-1 as on-line system for GIM II applications.

3. January 1975

Install the ORACLE mass storage system and begin acceptance tests of functional specifications of the system.

4. March 1975

Complete conversion from ASP 2.6 to ASP 3.1 software. ASP 3.1 becomes the operational system.

5. April 1975

Complete acceptance testing of ORACLE system with ASP 3.1 software. Begin operational test of ORACLE with selected batch and on-line applications.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

6. July 1975

As the first step toward replacement of the IBM 360/195 computer, install IBM 370/168-1 as an ASP main processor. As an alternative, the IBM 370/168-1 may be used to replace 158-2 for VM/370 service and the replacement of the IBM 360/195 may be deferred.

7. August 1975

Transfer ASP support processor function from IBM 360/65-1 to IBM 370/168-1, continuing to use the IBM 370/168-1 as an ASP main processor. At this point the ASP system will consist of the IBM 360/195 and the IBM 370/168-1. Transfer the GIM II on-line applications from IBM 360/67-1 to IBM 360/65-1. Take the IBM 360/67-1 system out of service.

8. September 1975

Install IBM 370/168-2 as an ASP main processor. The IBM 360/195 will be taken out of service. It will be held in standby status just long enough to assure that the IBM 370/168-2 is performing satisfactorily.

9. October 1975

Transfer the on-line applications from the IBM 370/158-1 to the IBM 370/168-2. Set up the IBM 370/158-1 as a second VM 370 system for interactive users and a SAFE development system.

10. January 1976

Complete operational testing of ORACLE system and put into production.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

11. July 1976

Install IBM 370/168-3 and VM 370 for interactive user service.

Transfer IBM 370/158-2 to SAFE on-line applications.

12. July 1977

Install IBM 370/168-4 for on-line applications.

13. October 1977

Take IBM 360/65-1 and 2 out of service.

14. January 1978

Install IBM 370/168-5 for SAFE on-line applications.

15. March 1978

Release the IBM 370/158-2.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

COMPUTER SYSTEM USE AT MAJOR MILESTONES

No.	Date	On-Line Service		ASP-BATCH		System Inventory		
		CMS	Other Applications	Mains	Support	In	Out	Total
	Current	67-1	65-2, 158-1	195	65-1	-	-	5
1	Oct 74	67-1, 158-2	65-2, 158-1	195	65-1	158-2	-	6
2	Dec 74	158-2	65-2, 158-1, 67-1	195	65-1	-	-	6
3			(Oracle Installed)					
4			(ASP 3.1 Conversion)					
5			(Oracle Accept. Test Completed)					
6	Jul 75	158-2	65-2, 158-1, 67-1	195, 168-1	65-1	168-1	-	7
7	Aug 75	158-2	65-2, 158-1, 65-1	195, 168-1	168-1	-	67-1	6
8	Sep 75	158-2	65-2, 158-1, 65-1	168-1, 168-2	168-1	168-2	195	6
9	Oct 75	158-2, 158-1	65-2, 65-1, 168-2	168-1, 168-2	168-1	-	-	6
10	Jan 76		(Oracle Production)					
11	Jul 76	158-1, 168-3	65-2, 65-1, 168-2, 158-2	168-1, 168-2	168-1	168-3	-	7
12	Jul 77	158-1, 168-3	65-2, 65-1, 168-2, 158-2, 168-4	168-1, 168-2	168-1	168-4	-	8
13	Oct 77	158-1, 168-3	168-2, 158-2, 168-4	168-1, 168-2	168-1	-	65-1&2	6
14	Jan 78	158-1, 168-3	168-2, 158-2, 168-4, 168-5	168-1, 168-2	168-1	168-5	-	7
15	Mar 78	158-1, 168-3	168-2, 168-4, 168-5	168-1, 168-2	168-1	-	158-2	6

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

25X1

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

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Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

VII. Alternatives

During the course of the development of the plan many equipment configurations were considered for batch and on-line CP/CMS service requirements. The major alternatives that were reviewed are discussed in the following paragraphs.

ON-LINE SERVICE TO INTERACTIVE USERS (CP/CMS)

Alternative 1: Upgrade IBM 360/67 systems.

Initially, it was felt that a quick improvement in CP/CMS support could be obtained by increasing the memory of the IBM 360/67's and providing the means for supporting 3330-like disk storage on these systems. However, the attempt to use this type of disk for CRS on-line applications was not successful because of difficulties with the CDC block multiplexor. The IBM 360/67-2 was replaced with an IBM 370/158 and, thus, the idea of upgrading the IBM 360/67's and later using two systems for CP/CMS service was abandoned as impractical.

Alternative 2: Installation of an IBM 370/168 by 1 January 1975.

It has been estimated that an IBM 370/168 could handle 200 terminals simultaneously with satisfactory user response. This would be a significant improvement over present service which is currently peaking at 70 active terminals. With an IBM 370/168 the new VM/370 software would be used, permitting us to phase out CP/CMS software. The IBM 370/168 would cost about $60,000 a month more than an IBM 370/158, increasing by $360,000 unfunded FY75 ADP equipment costs which are currently estimated at $600,000. A 370/168

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

would also require about twice the physical space of a 370/158, and it would also require coolant water, making physical installation more difficult.

Alternative 3: Installation of an IBM 370/158 by 1 October 1974, or sooner if possible.

An IBM 370/158 would provide the same opportunity for using VM/370 software as an IBM 370/168. It would not require coolant water or as much space. The physical installation would be simpler enabling us to install this system more quickly. Since we already have one IBM 370/158 installed, we have experience with this equipment, although VM 370 system software is not currently in use. Maximum memory capacity is 4 million bytes compared with 1 million bytes on the present IBM 360/67. Three million bytes would be ordered. It is expected that response time could be improved and the number of active terminals could be increased from 70 to 90. The installation of IBM 370/158-2 appears to be the least costly, quickest, and most feasible method for improving CP/CMS service over the next 12 to 18 months. This alternative was selected for the OJCS system plan.

BATCH PROCESSING SERVICE

Alternative 1: Retain the IBM 360/195 system; increase its memory to 3 million bytes.

The IBM 360/195 is a very powerful computer. Its power is particularly advantageous for long CPU bound jobs of the type processed for OD&E. The productivity of this computer can be increased through expansion of memory to a maximum of 4 million bytes, but memory is relatively expensive. The monthly rental increase for

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SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

an additional million bytes of memory is approximately $20,000 for the IBM 360/195, $6,000 for the IBM 370/158, and $5,200 for the IBM 370/168. The 360/195 does not appear to be as well suited to on-line applications as the IBM 370/168. A major concern with the IBM 360/195 is its limited future development. IBM has switched its effort to the 370 series and other developmental projects; the IBM 360/195 is becoming an obsolescent system. The backup systems that must be used when the IBM 360/195 is out of service are far less powerful (on the average about one-seventh). This imbalance will become more critical as the batch workload approaches the full capacity of the IBM 360/195.

Alternative 2: Replace the IBM 360/195 with two IBM 370/168's.

The advantages seen with a replacement of the IBM 360/195 by two IBM 370/168's are:

a. Compatible with other 370 systems installed or or to be installed.
b. Two balanced throughout paths for batch service.
c. Better stability and backup.
d. Improved hardware and software technology.
e. Ability to continue to use OS/MVT software until satisifed with the stability and performance of VS-2 operating software.
f. Potential for increased memory (up to 8 million bytes on each IBM 370/168) at one quarter the cost.

No significant increase in overall batch service capacity is projected for this alternative. Since the IBM 370/168 is a slower com-

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

SECRET
Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

puter, the processing time for a large CPU bound job would increase. On the other hand, the increased memory (4 million bytes planned for each IBM 370/168) would allow core restrictions to be eased where desirable. Also the IBM 370/168's would be used for on-line applications that are currently on the IBM 370/158-1. Two 4 million byte IBM 370/168's with drums, channels, systems disks and extra use charges would cost approximately $280,000 per month. The comparable cost for a 2 million byte IBM 360/195 is $210,000. The power of the IBM 360/195 is a strong factor in weighing these alternatives, but the flexibility that would be available with two IBM 370/168's and the longer life anticipated for these systems has caused this alternative to be used in the OJCS system plan.

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Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

VIII. Major Issues and Uncertainties

There is no assurance that the pace of OJCS expansion in computer service will match future requirements. An attempt has been made to strike a balance between requirements that could possibly occur and those that are likely to occur. This is necessary in order to develop a system plan with reasonable parameters for personnel and funds and one that can be fully justified. On the other hand, one or more of these requirements could possibly develop faster or in larger measure than anticipated. Some examples follow:

Batch Computer Service - It is possible that planned improvements in GIM on-line applications and interactive service could slow down the growth in batch service. Unfortunately it is also possible that the opposite will occur and our batch projections will prove to be underestimated, forcing us to retain the 360/195.

Interactive Service - Although we plan to have two IBM 370/158's providing VM/370 service by the end of 1975, improved service in this area could spark an even greater demand requiring earlier installation of IBM 370/168 equipment.

GIMS Applications - There are two unknowns here: the rate of growth in GIM users, particularly for MAP applications, and the degree to which we can improve the internal efficiency of GIM software. It is possible that we may need a dedicated 370/168 by December 1975 instead of partial support from a 370/168 and a dedicated 360/67.

SAFE - We plan to support 50 SAFE terminals by the end of FY-76. If the user buildup to the 500 terminals projected by

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

CRS develops more rapidly a dedicated computer could be required earlier than scheduled.

COINS - It is not certain when OJCS will be asked to support a host computer in this network. None is included in the plan. Since security is still a problem, a stand-alone computer would most likely be required.

Word Processing - A SCRIPT system utilizing the interactive computer service, the ATS system in the [redacted] center, and IBM MCST's 25X1 are the major tools used for this function. A mini computer system with printers and CRT displays could be come a requirement.

APL - A fast response system with good analytical software and strong OJCS programming support could cause an explosion in the use of the APL language and its many application programs. The result could be a system which consumes half of the capacity of a 370/158 or a stand-alone computer.

Mass Storage - Physical dispersion of the main OJCS Com-Puter Center or a significant increase in the DD/O demands for mass storage could require another copy of the ORACLE hardware.

If all of the above items were to develop into firm requirements they would add over $7,500,000 to the equipment costs shown in this plan for FY-76 and $6,000,000 to rentals in the following years. Additionally 10-15 positions would be required for computer operators and 3-5 positions for systems programmers.

During the past five years a major constraint on OJCS planning has been the amount of space available for computer equipment. The planned installation of the ORACLE mass storage system has forced

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6

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an allocation of space on the first floor of Headquarters building. At least 2000 square feet of additional space should be made ready before the installation of the first IBM 370/168 planned for July 1975. Thereafter additional increments of space will be required depending upon the actual rate of OJCS expansion. From an economic viewpoint and to avoid constant disruption of costly computer facilities it would be wise to plan for a major one-time expansion in computer equipment space to take care of long-term growth in computer equipment.

Approved For Release 2006/04/26 : CIA-RDP86-01019R000100230004-6